FOURTH BI-MONTHLY PROGRESS REPORT
UNIVERSITY OF ALASKA
ERTS PROJECT 110-3
March 31, 1973

A. TITLE OF INVESTIGATION: Identification, definition and mapping of terrestrial ecosystems in interior Alaska

B. PRINCIPAL INVESTIGATOR: J. H. Anderson

C. PROBLEMS IMPEDING INVESTIGATION:

1. Digital color display unit not yet available

2. Simulated color-infrared scenes (Product Type B) for two test areas ordered on January 7 from NASA not yet available

D. PROGRESS REPORT:

1. Accomplishments during reporting period

a. ERTS photographic imagery for three intensive training sites and color-key image for one of these studied; NASA-Houston aerial photography and field notes used for ground truth

b. Enlargements in simulated color-infrared of two of these sites ordered from Project 110-1 (to be used for further interpretation and for mapping). These products, ordered March 15, to be available by April 2.

i. 1033-21011 (including test area no. 5): Southeastern quarter of scene to be enlarged to scale of 1:250,000. Primary interest in transect from Tanana River Flats to Murphy Dome, including Bonanza Creek Experimental Forest.

ii. 1029-20381 (including test area no. 6): Whole scene to be enlarged to 1:500,000. Primary interest in Eagle Summit Research Area, which may later be enlarged further for mapping.

c. These two scenes also ordered from NASA for comparative purposes.

d. Study of color coded density slice displays of Eagle Summit area made from black and white aerial photographs

e. Meeting with Project 110-2 personnel (McKendrick, Branton, Scorup) to compare and discuss research results and to

discuss vegetation classification and mapping techniques. This investigator proposed that the Fosberg vegetation classification be considered for use in Alaska (Reference: Fosberg, F. R. 1961. A classification of vegetation for general purposes. Tropical Ecology 2: 1-28.) The need for continuing close interaction between Projects 110-2 and 110-3 was reaffirmed.

f. Arrangements made for working meetings with Project 110-2 personnel and Dr. S. Rieger, State Soil Scientist, for study of vegetation-soil relationships using ERTS imagery; first meeting to be mid-April, with several additional meetings thereafter.

g. Meeting of U of A ERTS investigators with participants in recent ERTS Symposium (Miller, Gedney, Wright) to learn about and discuss symposium activities. Also, discussion with U of A ERTS computer systems and program specialist (Porter) regarding recent trip to see progress on assembly of digital CDU at Interpretation Systems, Inc., in Kansas.

h. Presentation by this investigator of illustrated lecture on ERTS program, particularly Project 110-3, to non-ERTS U of A audience.

2. Plans for next reporting period

a. Study of color-infrared enlarged prints covering three test areas

b. Study of enhanced and enlarged black and white prints of these areas

c. Development of classification of vegetation compatible with the level of vegetation information provided by ERTS products, these classes to serve primarily as mapping units

d. Preparation of vegetation maps of these areas by tracing on acetate overlays of selected products

e. Finalization of summer field site visitation schedule for ground truth

f. At least one working meeting with Project 110-2 and soil scientist

g. Examination, screening, etc. of 1973 ERTS imagery. Search for suitably cloud-free images covering test areas for which such imagery not yet available

h. Learn use of digital CDU and examine CRT displays from tapes of the three intensive training sites now under study

i. Continued work on Cook Inlet area spruce beetle infestation study (expected to be finished in the near future)

E. SIGNIFICANT RESULTS:

1. Tanana River Flats to Murphy Dome transect

This is an intensive training site within test area no. 5, the Bonanza Creek Experimental Forest-Fairbanks area. The transect includes the experimental forest. It contains a broad range of vegetation-landform types and probably is representative of the general region.

Standard NASA 9½-inch bulk black and white MSS prints in four bands were examined closely, using a magnifying glass and strong transmitted as well as incident light. The scene used was 1033-21011. A color-key image was also studied. Both product types were compared with the NASA-Houston aerial photography of the transect and first-hand knowledge of the area.

The color-key image was found inferior to the black and white prints in information content and interpretability. It seems that this product type may not be feasible, although this will be tested with a few additional color-key images for other areas.

The band 7 print provided the most vegetation information. Band 6 was nearly as useful, but bands 4 and 5 were of little use in discerning vegetation types, although major roads and a railroad could be seen on these.

On the band 7 print, the most apparent distinction was between spruce-dominated vegetation and all other types. The spruce vegetation appeared dark, whereas the other types were gray to light gray. Spruce stands as small as approximately 100 m in the shortest dimension were easily distinguished. Other vegetation types could also be distinguished at about the same spatial level, although tonal contrasts were more subtle. All major stands of vegetation appearing on the aerial photographs could be discerned on the band 7 print. These included, besides spruce forest, broad-leaved forest, treeless muskeg and bog vegetation, muskeg with scattered spruce, vegetation wherein spruce and broad-leaved species share dominance, shrub-dominated vegetation and vegetation comprising herbaceous species, primarily at higher elevations.

The tonal differences between some of these was slight, and positive interpretations of units of a given tone could only be made with reference to the aerial photographs. Tonal contrasts were so subtle that a given tone, except for the densest (spruce forest) and lightest (sparse alpine vegetation), could not be recognized in one place as the same as in another. Therefore some form of image contrast enhancement or density slicing, as an adjunct to what the eye alone can do, may be necessary before vegetation identifications, except at the coarser levels of distinction, can be extended over larger areas.

Because of the relatively large amount of vegetation information available on the band 7 print, it is believed that a second print, enlarged to an appropriate scale, might serve for mapping. Interpretations could be facilitated by simulated color-infrared prints of

9½-inch, hence less expensive format, and by CRT displays.

This method of mapping, i.e. tracing on an acetate overlay, could serve many purposes (see the NASA report A New Vegetation Map of the Western Seward Peninsula, Alaska, by J. H. Anderson and A. E. Belon), but it would not be as good as the use of a zoom transfer scope. This is because the tracing method does not permit image rectification and precise adjustment to given base maps, such as U.S. Geological Survey topographic sheets. Therefore the present investigator, along with several U of A ERTS colleagues, will continue to try to obtain funding for a zoom transfer scope as the most desirable mapping instrument.

2. Eagle Summit Research Area

MSS black and white prints covering the Eagle Summit Research Area were studied as above in conjunction with aerial photography and field notes.

This area is characterized by treeless shrub and herbaceous tundra vegetation types and areas of sparse vegetation on predominantly rocky surfaces. At lower elevations, in the vicinity of the treeline, stands of shrub vegetation with scattered spruce trees occur.

The band 5 print permitted the easiest distinctions between areas of little or no vegetation and vegetated areas. Ridge crests and high valley side slopes appeared light gray in contrast to the dark grays at lower elevations, which predominate in the scene. On bands 6 and 7 this distinction is less apparent but may still be made. In all bands the tonal contrast between vegetation containing some, or dominated by spruce trees and other types of vegetation is slight compared to the area examined in 1, above. Positive identifications of spruce vegetation were not possible except by reference to the air photos. This apparent lesser interpretability may be a result of differences in processing between scenes 1029-20381 and 1033-21011. This idea will be explored with the forthcoming color-infrared prints of both scenes and black and white products prepared by Project 110-1.

A possible difficulty in vegetation interpretations in the Eagle Summit area stems from the mountainous character of the terrain (and thus may appear in many Alaskan scenes). Northeast, north and northwest facing slopes receive sunlight at a considerably lower angle of incidence than flat areas and more or less south-facing slopes. This results in major differences in the spectral signatures, even though the general vegetation types may be quite similar. There are, of course, many floristic differences and often structural differences between vegetation on north and south facing slopes. But the general composition and physiognomy is the same in most cases, for given elevations, and therefore is not necessarily distinguishable on ERTS imagery. Because of the low sunlight angles on northerly slopes, these generally appear of medium gray tone, compared to the light medium to light grays of ridge crests and southerly slopes, even at lower elevations. On bands 4 and 5, all tones are relatively darker.

Some areas on northerly slopes are in actual shadow and appear particularly dark in tone, even though it is known that no spruce forest occurs here and that often sparse vegetation or rock outcrops do, which would appear quite light under regular sun illumination. Of course these tonal differences are the primary character of the image permitting the determination of topography. Nevertheless, these differences appear greater than can be explained on the basis of vegetation alone.

3. Wiseman area

The vicinity of the village of Wiseman was studied on ERTS black and white MSS prints (1017-21115) and compared with aerial photographs and the as yet unpublished results of vegetation studies made in the area by this investigator. As in the Eagle Summit area, tonal differences between vegetation types were very slight and no positive identifications could be made without reference to the air photos or ground truth data. It seems likely, however, that higher contrast black and white prints of this area could be useful for identification of vegetation types at a similar level as in the Tanana River Flats-Murphy Dome transect. High contrast and enlarged black and white prints of the Wiseman area and a color composite of this area, about a three cm square portion from near the center of the image, have been ordered from Project 110-1.

4. Color coded density slice scenes

Color coded density slice scenes were produced by Robert Porter from black and white NASA aerial photographs of the Eagle Summit area with the image analyzer and CRT equipment of Interpretation Systems, Inc., at Lawrence, Kansas. Several photographs of these were studied by this investigator, but the colors were found to have no relationship with the distribution of vegetation types in the area. However, it is noted that this was only an experimental attempt, using scenes prepared by a person with no particular knowledge of the vegetation of the area.

5. Study of spruce beetle damage in the Cook Inlet area

The spruce beetle study was continued during the reporting period using photographs of CAV displays provided by F. P. Weber of the U.S. Forest Service remote sensing laboratory at Berkeley. These photos are of high quality and have comparatively good resolution. A collaborator in forest entomology, R. C. Beckwith of the Institute of Northern Forestry, U.S. Forest Service, on this campus is studying these at present.

F. PUBLICATIONS:

Anderson, J. H., L. Shapiro and A. E. Belon. Vegetative and geologic mapping of the western Seward Peninsula, Alaska, based on ERTS-1 imagery. To be published in the Proceedings of the NASA/GSFC ERTS Symposium, March 5-9, 1973.

G. RECOMMENDATIONS:

None

H. CHANGES IN STANDING ORDER FORMS:

None

I. ERTS IMAGE DESCRIPTORS FORMS:

Since no further images have been selected for analysis since the last reporting φeriod, no descriptors are provided at this time.

J. DATA REQUEST FORMS:

One data request was submitted during the reporting period, dated February 2, 1973. The data have not been received.

A data query was submitted, dated March 21, to obtain information on the availability of imagery prior to August 1, 1972. There has been no reply yet.

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TITLE OF INVESTIGATION: Identification, definition and mapping of terrestrial ecosystems in interior Alaska

DISCIPLINE: Environment

SUBDISCIPLINE: Other: Vegetation analysis, mapping and phenology

SUMMARY OF SIGNIFICANT RESULTS:

MSS bulk black and white prints covering a test area in interior Alaska, the Tanana River Flats to Murphy Dome transect, were studied and compared directly with NASA aerial photography. Six major vegetation types were identified on the band 7 print on the basis of tonal differences; spruce forest, broad-leaved forest, treeless muskeg and bog vegetation, muskeg with scattered spruce, mixed spruce-broad-leaved forest, shrub dominated vegetation and vegetation comprising herbaceous species. Spruce forest vegetation occurring in stands as small as approximately 100 m in the shortest dimension could readily be identified. Tonal contrasts between the other vegetation types were more subtle, and it was not possible to be certain, through visual examination alone, ~~to be certain~~ that a given tonal unit was the same as or different from one elsewhere. Therefore some form of image enhancement may be necessary for extending interpretations to other areas. A black and white print of band 7, enlarged to an appropriate scale, should be useful for vegetation mapping, particularly with the support of enhancement products for the same scene. Band 6 had only slightly less information on vegetation, but bands 4 and 5 were of no value except perhaps for distinguishing vegetated and non-vegetated areas.

A color-key image of this area was also studied, but was found inferior to the black and white prints in vegetation information content and interpretability.

Black and white imagery covering the Eagle Summit Research Area, an intensive training site in ERTS test area no. 6, was studied. Here, distinctions between vegetation types were less apparent, and even known areas of spruce forest could not be clearly discerned, even though this type should appear quite dark on band 6 and 7 products. Band 5 showed a clear distinction between non- and sparsely vegetated areas, such as ridge crests, but no good distinctions within either of these. Band 4 was somewhat less interpretable than band 5. It seems likely that a black and white image

of band 7 with increased contrast could permit vegetation type distinctions with at least the precision as in the area discussed above.

Vegetation interpretations in the mountainous Eagle Summit area were further inhibited by differences in spectral characteristics on northerly and southerly slopes resulting from major differences in angle of sun illumination. These differences are believed in some cases considerably greater than could be accounted for by vegetation differences alone, even if a print prepared for maximum contrast between only slightly different spectral levels were to be used.

Black and white prints for the Wiseman area were also studied and compared with NASA aerial photography and field notes, but were found to be no more informative than the Eagle Summit area scenes.

All three of these areas will be studied further using enhanced black and white products, simulated color-infrared products and digital data CRT displays. Vegetation mapping will be conducted with a selected photographic product, enlarged to an appropriate scale, with interpretations during the course of mapping supported by reference to various enhanced or otherwise highly processed products of the same scene.